

Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) **EP 0 864 749 B1**

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
02.06.2004 Bulletin 2004/23

(51) Int Cl.⁷: **F04B 27/18**

(21) Application number: **98104473.8**

(22) Date of filing: **12.03.1998**

(54) **Electromagnetic control valve**

Elektromagnetisches Regelventil

Soupape de contrôle électromagnétique

(84) Designated Contracting States:
DE FR GB

(30) Priority: **14.03.1997 JP 6067097**

(43) Date of publication of application:
16.09.1998 Bulletin 1998/38

(73) Proprietors:

- **Kabushiki Kaisha Toyota Jidoshokki**
Kariya-shi, Aichi-ken (JP)
- **Kabushiki Kaisha Saginomiya Seisakusho**
Tokyo 165-0033 (JP)

(72) Inventors:

- **Kawaguchi, Masahiro**
Kariya-shi, Aichi-ken, 448-8671 (JP)

- **Suitou, Ken**
Kariya-shi, Aichi-ken, 448-8671 (JP)
- **Murase, Masakazu**
Kariya-shi, Aichi-ken, 448-8671 (JP)
- **Morishita, Atsuyuki**
Kariya-shi, Aichi-ken, 448-8671 (JP)
- **Okada, Tomoo, c/o K.K. Saginomiya Seisakusho**
Sayama-shi, Saitama-ken, 350-1327 (JP)

(74) Representative:

Reinhard - Skuhra - Weise & Partner
Friedrichstrasse 31
80801 München (DE)

(56) References cited:

EP-A- 0 300 831	EP-A- 0 628 722
US-A- 4 730 986	US-A- 5 205 718
US-A- 5 282 329	US-A- 5 531 572

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 0 864 749 B1

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to an electromagnetic control valve for a variable capacity compressor and, more particularly, to an electromagnetic control valve for a variable capacity compressor employed in a cooling unit for vehicles.

Related Art

[0002] Japanese Patent Application Laid-Open No. 8-109797, filed by the present applicants, discloses an electromagnetic control valve for a variable capacity compressor used in a cooling unit for vehicles (hereinafter referred to as "prior art A"). This electromagnetic control valve can reduce the load on the engine at the time of starting a vehicle, and it can be small in size. Furthermore, the valve characteristics of the electromagnetic control valve can readily be changed.

[0003] Fig. 5 is a schematic view of a capacity control mechanism of a variable capacity compressor in which the above electromagnetic control valve is employed.

[0004] A variable capacity compressor 20 has an electromagnetic capacity control valve 1-3 shown in Fig. 6 secured to its attachment concave portion 40. A plurality of cylinders 25 are provided inside a head portion 41 which communicates with a crankcase 21 of the compressor 20, and a piston 26 is slidably provided inside each cylinder 25. A driving shaft 27 is rotatably provided in an area extending from the crankcase 21 to the head portion 41. The driving shaft 27 is driven by an engine (not shown) via a pulley 34 and a belt 35 provided outside the crankcase 21.

[0005] The driving shaft 27 is provided with a wobble plate 29 which can vary the inclination of itself. The wobble plate 29 is linked to the pistons 26 through piston rods 24. The wobble plate 29, which is inclined as shown in Fig. 5, is rotated by the driving shaft 27, so that the piston rods 24 and the pistons 26 can move back and forth. By doing so, the attachment angle of the wobble plate 29 can be automatically adjusted depending on the differential pressure between a control chamber pressure Pc in the crankcase 21 and a suction side pressure Ps in the cylinders 25, while the stroke width of the pistons 26 can be changed depending on the inclination of the wobble plate 29.

[0006] Each cylinder 25 is provided with a suction opening S and a discharge opening D, and connected, via passages d and s, to a condenser 31, an evaporator 32, and an expansion valve 33. The electromagnetic control valve 1-3 communicates with a crank chamber C (or a control chamber C) in the crankcase 21 via a refrigerant passage 36, with the suction opening S via a refrigerant passage 37, and with the discharge open-

ing D via a refrigerant passage 38.

[0007] Fig. 6 is a sectional view of the electromagnetic control valve of the prior art A when not energized.

[0008] The electromagnetic control valve 1-3 includes: (a) a valve member 8a which is provided in a valve chamber 18 formed by an upper main body 7 and a valve main body 17, and which repeatedly comes into contact with and depart from a valve seat 17d formed in a valve opening 17k situated on the way to a Pc pressure introducing opening 17h leading to the crank chamber C in the crankcase 21; (b) a Pd pressure introducing opening 17i which is formed on the opposite side of the Pc pressure introducing opening 17h from the valve chamber 18, and which leads to the discharge-side refrigerant passage 38 of the compressor 20; (c) a valve guide 17e extending from the Pd pressure introducing opening 17i to the Pc pressure introducing opening 17h; (d) a valve stem 8b which is integrally formed with the valve member 8a, and which is movable in the vertical direction inside the valve guide 17e; (e) a pushing unit 9 for pushing the valve member 8a in the valve opening direction; (f) a plunger 5 situated above the upper main body 7 which is vertically movable by virtue of the suction power of an electromagnetic coil 15, and which pushes the valve member 8a in the valve closing direction via a connecting rod 6 which is vertically movable in a through opening 7b of the upper main body 7; (g) a pressure equalizing opening 17q formed through the valve main body 17 and extending from the valve chamber 18 to the Pd pressure introducing opening 17i; (h) pressure bellows 11 formed below the Pd pressure introducing opening 17i and situated in a space 17g which communicates with the suction side S of the compressor 20; and (i) a corrective pin 10 which comes into point-contact with the lower surface of the valve stem 8b at its upper end and with the pressure bellows 11 at its lower end, and which is movable in a guide opening 17f extending from the Pd pressure introducing opening 17i to the space 17g.

[0009] With the suction pressure Ps of the piston cylinders 25 in Fig. 5, the pressure bellows 11 control the opening angle of the valve member 8a, which is situated in the refrigerant passage extending from the refrigerant passage (a discharge pressure supply passage) 38 to the crankcase 21.

[0010] A casing 2, a coil guide 3, the plunger 5, the connecting rod 6, the upper main body 7, the electromagnetic coil 15, and a plunger tube 16, integrally constitute an electromagnetic actuator. The opening angle of the valve is controlled depending on the current supplied to the electromagnetic coil by the electromagnetic actuator.

[0011] Japanese Patent Application Laid-Open No. 5-99136 also discloses an electromagnetic control valve for a variable capacity compressor (hereinafter referred to as "prior art B"). This electromagnetic control valve is provided with a first valve in the refrigerant passage extending from the high-pressure discharge side (Pd) to

the crankcase side (Pc) of the compressor, and a second valve in the refrigerant passage extending from the crankcase side (Pc) to the suction side (Ps) of the compressor. Thus, the pressure Ps will not be directly affected by the pressure Pd, and the pressure Pc will not become too high when the discharge capacity decreases as the discharge gas (Pd) is introduced into the crank chamber.

[0012] With the electromagnetic control valve of the prior art A, the variable capacity point of the compressor can be varied by changing the set point of the suction pressure Ps. Since the absolute value of the pressure Ps needs to be obtained in such method, high reliability is required in the sealed structure of the pressure bellows and the like. This causes a problem that it is expensive to produce such sealed structure formed by beam welding or the like.

[0013] In each electromagnetic control valve of the prior art A and prior art B, the suction pressure Ps of the compressor ranges from 1.5 to 4 Kg f/m² depending on the load, and it nears 10 Kg f/m² at the time of starting. To control as desired under a heavy load, large electromagnetic force is required to meet the high suction pressure, and therefore, the coil should be large in size.

[0014] Further problems with the electromagnetic control valve of the prior art are that large electromagnetic force is required in obtaining a wide range of pressure, and that the sealed structure makes the hysteresis undesirably high, resulting in unreliable control operations.

SUMMARY OF THE INVENTION

[0015] The principal object of the present invention is to provide an electromagnetic control valve which is capable of controlling with low electromagnetic force at low cost.

[0016] In accordance with one aspect of the present invention, an electromagnetic control valve comprising: a valve member situated in a valve chamber formed by an upper main body and a valve main body; a valve seat with which the valve member repeatedly comes into contact, and which is formed at a valve opening in a passage between the valve chamber and a discharge pressure introducing opening formed below the valve chamber and leading to a discharge-side introducing conduit of a compressor; a crankcase inner pressure introducing opening which is formed on the opposite side of the discharge pressure introducing opening from the valve chamber, and which leads to a crank chamber of the compressor; a valve guide extending from the crankcase inner pressure introducing opening to the discharge pressure introducing opening; a valve rod vertically movable inside the valve guide; a plunger which pushes the valve member in a valve closing direction with the help of a vertically movable connecting rod inside a through opening formed through the upper main body, and which is situated above the upper main body

and being vertically movable by virtue of the suction force of an electromagnetic coil; an inner pressure equalizing opening formed in the valve main body and extending from the valve chamber to the crankcase pressure introducing opening; a suction pressure introducing opening leading to the suction side of the compressor; a pressure-sensitivity control mechanism which is disposed in a space leading to the suction side of the compressor, and which faces to the crankcase inner pressure introducing opening of the valve main body; and a piston spring for receiving piston pressure. The pressure-sensitivity control mechanism is formed by a piston which comes into contact with the bottom surface of the valve rod. The differential pressure between the crankcase inner pressure and the suction pressure can be detected by the piston. With the detected differential pressure, the valve member controls the flow of the refrigerant from the discharge side (high-pressure side) to the crankcase side of the compressor.

[0017] In the above electromagnetic control valve, the top surface of the piston is chamfered so as to form an escape valve which includes the side surface of the piston as a slide portion. Another slide portion is formed at the upper end or in the vicinity of the upper end of the lower portion of the valve main body. The escape valve separates from the lower end of the valve rod when the differential pressure between the crankcase inner pressure and the suction pressure surpasses a predetermined value. The slide portion of the escape valve separates from the slide portion of the lower portion of the valve main body, so that the refrigerant pressure can be released from the crankcase side to the suction side of the compressor.

[0018] The above electromagnetic control valve further comprises an external control unit for electromagnetically activating the valve member to control the refrigerant flow from the discharge side (high-pressure side) to the crankcase side of the compressor upon receipt of detection signals transmitted from a temperature sensor and a pressure sensor provided to the electromagnetic control valve and an external signal transmitted from a driving mode control device for vehicles or the like.

[0019] In the prior art, it is necessary to vary the pressure Ps in the range of 0 to 4 kg f/cm². In the present invention, on the other hand, the differential pressure between the pressure Pc and the pressure Ps can be set at approximately 1 Kg f/cm² under no load (in full-unloading mode). Thus, an electromagnetic control valve which can control with small electromagnetic force can be provided. The differential pressure between the pressure Pc and the pressure Ps can be detected by a simply structured member such as a piston, and only small electromagnetic force is required. Thus, the electromagnetic coil can be made smaller, the production costs can be reduced, only a small space is required in attachment, and the weight can be reduced. Unlike in controlling the differential pressure between the pres-

sure P_c and the pressure P_s , the differential pressure between the pressure P_d and the pressure P_c is 2 Kg / cm^2 or larger, so the diameter of the valve opening can be made smaller than that.

[0020] The above and other objects and features of the present invention will be more apparent from the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] Fig. 1 is a sectional view of one embodiment of an electromagnetic control valve in accordance with the present invention.

[0022] Fig. 2 is a sectional view of a second embodiment of an electromagnetic control valve in accordance with the present invention.

[0023] Fig. 3 is a sectional view illustrating the escape valve shown in Fig. 2 when it is open.

[0024] Fig. 4 is a schematic view of an external control unit of a third embodiment of the present invention.

[0025] Fig. 5 is a schematic view of the capacity control mechanism in a variable capacity compressor in which a conventional electromagnetic control valve.

[0026] Fig. 6 is a sectional view illustrating the conventional electromagnetic control valve when not energized.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0027] The following is a description of embodiments of the present invention, with reference to the attached drawings.

[Embodiment 1]

[0028] A capacity control mechanism for a variable capacity compressor in which an electromagnetic control valve is used is shown in Fig. 5. Fig. 1 shows an electromagnetic control valve 1-1 attached to such capacity control mechanism.

[0029] The electromagnetic control valve 1-1 is made up of a control valve portion 1a and an electromagnetic proportional control unit 1b. A valve main body 17 is divided into a valve main body upper portion 17a, a valve main body intermediate portion 17b, and a valve main body lower portion 17c.

[0030] The valve main body upper portion 17a includes a concave portion. A valve chamber 18 is formed by the upper surface 17j of the concave portion and the lower portion 7b of an upper main body 7. The valve main body upper portion 17a is also provided with a valve seat 17d.

[0031] The valve main body lower portion 17c also includes a concave portion. A piston 12-1a having a rectangular shape minus one side in cross section is formed in a piston lower space 17g which leads to the

suction side of the compressor such that the upper surface of the piston 12-1a faces to a P_c pressure introducing opening 17h of the valve main body 17. The piston 12-1a has a relief aperture 12-1b for letting fluid flow from P_c to P_s (see Fig. 1) to maintain safety in control operations. With a much simpler structure, the relief aperture 12-1b replaces the large-scale orifice O of the capacity control mechanism of the prior art shown in Fig. 5.

[0032] A spring adjustment member 14 is screwed into the inner surface of the lower portion of the valve main body lower portion 17c, thereby forming the above-mentioned piston lower space 17g. When the piston 12-1a is pushed in the opening direction of a valve member 8 by an encouraging means, i.e., a piston spring 13, it will be brought into contact with the lower surface of a valve rod 8b. A P_s pressure introducing opening 17s is formed in the center of the spring adjustment member 14.

[0033] Between the valve main body upper portion 17a and the valve main body intermediate portion 17b, a P_d pressure introducing opening 17i leading to the discharging outlet D of the compressor 20 is formed. The P_d pressure introducing opening 17i communicates with a valve chamber 18 via a valve opening 17k. Between the valve main body intermediate portion 17b and the valve main body lower portion 17c, the P_c pressure introducing opening 17h is formed. The P_c pressure introducing opening 17h communicates with the valve chamber 18 via an inner pressure equalizing opening 17q.

[0034] The piston lower space 17g, which forms a cylinder chamber, of the valve main body lower portion 17c leads to the suction side S of the compressor 20. Circular grooves for accommodating sealing O-rings 42, 43, and 44 are formed on the outer peripheries of the valve main body upper portion 17a, the valve main body intermediate portion 17b, and the valve main body lower portion 17c, respectively.

[0035] Inside the valve chamber 18, the valve member 8, which is integrally joined to the valve rod 8b, freely comes into contact with and depart from the lower end of a connecting rod 6, and the valve portion 8a of the valve member 8 faces to and comes into contact with the valve seat 17d. The valve member 8 is subjected to the suction power of a coil acting on a plunger 5 guided by a guide pin 3b via the connecting rod 6, and to the pushing power of a plunger spring 4.

[0036] Inside a plunger tube 16, the upper main body 7 and the coil guide 3 are secured by welding. Inside a casing 2, an electromagnetic coil 15 surrounds the plunger tube 16. The plunger 5 can move in the axis direction inside a plunger chamber 19 situated between the upper main body 7 and the coil guide 3. The plunger 5 is provided with a through opening 5b for connecting both spaces formed above and below the plunger 5 inside the plunger chamber 19.

[0037] Below the plunger 5, the connecting rod 6 is inserted into a guide hole 7a formed in the center of the upper main body 7. The connecting rod 6 is slidable in

the vertical direction. Here, the upper end of the connecting rod 6 is in contact with the lower surface of the plunger 5 guided by a guide pin 3b, while the lower edge of it is in contact with the valve member 8.

[0038] The plunger spring 4 is formed in a center concave portion 3a of the coil guide 3, so that the plunger spring 4 can be interposed between the coil guide 3 and the plunger 5. Thus, the plunger 5 is pushed toward the valve chamber 18 by the plunger spring 4.

[0039] The electromagnetic control valve 1-1 is inserted into the attachment portion 40 of the compressor 20 until the casing 2 comes into contact with the outer surface of the head portion 41 of the compressor 20, as in the prior art shown in Fig. 6. Here, the Pc pressure introducing opening 17h communicates with a refrigerant path (Pc) (not shown), the piston lower space 17g communicates with another refrigerant path (Ps) (not shown) via the Ps pressure introducing opening 17s, and the Pd pressure introducing opening 17i communicates with yet another refrigerant path (Pd) (not shown).

[0040] As shown in Fig. 5, if the control chamber pressure Pc is higher than the suction side pressure Ps, the variable capacity compressor 20 operates in unloading mode in which a wobble plate 29 rises to shorten the compressing strokes. If the pressure Pc is equal to the pressure Ps, the variable capacity compressor 20 operates in full-loading mode. If the pressure control chamber C communicates with the discharging side D, the fluid will flow from Pd to Pc and the pressure Pc will become higher than the pressure Ps. If the pressure control chamber C is shut out from the discharging side D, the pressure Pc will be equal to the pressure Ps. In view of this, the capacity of the compressor 20 can vary from full-loading mode to full-unloading mode by employing the electromagnetic control valve 1-1, which adjusts the flow rate of the refrigerant by the suction side pressure Ps, between the pressure control chamber C and the discharging side D.

[0041] In such electromagnetic control valve 1-1, the differential pressure between the pressure Pc and the pressure Ps is detected by the piston 12-1a, and the valve for controlling the flow from the high-pressure side (Pd) to the pressure control chamber (Pc) operates depending on the detected differential pressure. The differential pressure between the pressure Pc and the pressure Ps is detected by varying the electromagnetic force (or the current), and the tilt angle of the wobble plate of the compressor is changed depending on the detected differential pressure, so as to vary the capacity of the compressor.

[Embodiment 2]

[0042] As shown in Fig. 3, the upper surface of an escape valve 12-2a having a mechanism of releasing pressure Pc is chamfered at both sides. This escape valve 12-2a has a concave portion 12-2b in the center of its upper surface, a slide portion 12-2c on its outer

periphery, and a spring receiving portion 12-2d on the lower surface. The piston string 13 is provided in a space which leads to the suction side of the compressor, so that it faces to the Pc pressure introducing opening 17h formed between the valve main body upper portion 17a and the valve main body lower portion 17c. The escape valve 12-2a having the pressure Pc releasing mechanism is situated such that the slide portion 12-2c repeatedly comes into contact with and depart from a slide portion 17c-1 formed at the upper end of the valve main body lower portion 17c.

[0043] When the differential pressure between the pressure Pc and the pressure Ps surpasses a predetermined value, the escape valve 12-2a having the pressure Pc releasing mechanism departs from the lower end of the valve rod 8b, and the slide portion 12-2c of the escape valve 12-2a departs from the slide portion 17c-1 of the valve main body lower portion 17c, thereby releasing the refrigerant pressure from the crankcase side (Pc) toward the suction side (Ps) of the compressor.

[Embodiment 3]

[0044] Fig. 4 shows an embodiment of an external control unit 60 connected to each terminal 50 of the electromagnetic control valves 1-1 and 1-2 of the first and second embodiments of the present invention.

[0045] In the external control unit 60, a controller 61 sends current to an external variable valve, i.e., the electromagnetic control valve 1-1 or 1-2, in an amount depending on the deviation detected by comparing detection signals 64 and 65 transmitted from the temperature sensor and the pressure sensor provided in the electromagnetic control valve 1-1 or 1-2 and an external signal 66 transmitted from the driving control unit of a vehicle with set values inputted beforehand into a controller setting device 67 provided on the controller 61.

[0046] The electromagnetic unit of the electromagnetic control valve 1-1 or 1-2 generates electromagnetic force depending on the current intensity. The electromagnetic force acts on the spherical surface of the valve member 8 so as to preventing the refrigerant from flowing from the discharging side (Pd) into the crankcase (Pc). As a result of this, the variable capacity point of the electromagnetic control valve 1-1 or 1-2 can be changed. Reference numeral 63 indicates a power source, and reference numeral 68 indicates a controller display.

[0047] Although the present invention has been fully described by way of examples with reference to the accompanying drawings, it is to be noted that various changes and modifications will be apparent to those skilled in the art. Therefore, unless otherwise such changes and modifications depart from the scope of the appended patent claims, they should be construed as being included therein.

Claims

1. An electromagnetic control valve comprising:

a valve member (8) situated in a valve chamber (18) formed by an upper main body (7) and a valve main body (17);

a valve seat with which said valve member repeatedly comes into contact, said valve seat being formed at a valve opening (17k) in a passage (17d) between the valve chamber and a discharge pressure introducing opening (17i) formed below the valve chamber and leading to a discharge-side introducing duct (38) of a compressor (20);

a crankcase inner pressure introducing opening (17h) formed on the opposite side of the discharge pressure introducing opening from the valve chamber, said crankcase inner pressure introducing opening leading to a crank chamber (21) of the compressor;

a valve guide (17e) extending from said crankcase inner pressure introducing opening to said discharge pressure introducing opening;

a valve rod (8b) vertically movable inside said valve guide;

a plunger (5) for pushing said valve member in a valve closing direction with a vertically movable connecting rod (6) inside a through opening (7a) formed through the upper main body, said plunger being situated above the upper main body and being vertically movable by virtue of suction force of an electromagnetic coil (15);

an inner pressure equalizing opening (17a) formed in the valve main body and extending from the valve chamber to said crankcase inner pressure introducing opening;

a suction pressure introducing opening (17s) leading to the suction side of the compressor;

a pressure-sensitivity control mechanism disposed in a space leading to the suction side (17g) of the compressor, said pressure-sensitivity control mechanism facing to said crankcase inner pressure introducing opening of the valve main body; and

a piston spring (13) for receiving piston pressure,

wherein

said pressure-sensitivity control mechanism is formed by a piston (12-1a, 12-2a) which comes into contact with the bottom surface of said valve rod to detect the differential pressure between a crankcase inner pressure and a suction pressure, and with the detected differential pressure, said

valve member controls flow of refrigerant from the discharge side (high-pressure side) to the crankcase side of the compressor.

2. The electromagnetic control valve according to Claim 1, wherein

the top surface of the piston (12-1a, 12-2a) is chamfered so as to form an escape valve which includes the side surface of the piston as a slide portion,

another slide portion is formed at the upper end or in the vicinity of the upper end of the lower portion of the valve main body (17),

the escape valve separates from the lower end of said valve rod (8b) when the differential pressure between the crankcase inner pressure and the suction pressure surpasses a predetermined value, and

the slide portion of the escape valve separates from the slide portion of the lower portion of the valve main body, so that a refrigerant pressure can be released from the crankcase (21) side to the suction side (5) of the compressor (20).

3. The electromagnetic control valve according to Claim 1 or 2, further comprising

an external control unit (60) for electromagnetically activating said valve member (8) to control the flow of refrigerant from the discharge side (high-pressure side D) to the crankcase (21) side of the compressor upon receipt of detection signals transmitted from a temperature sensor (64) and a pressure sensor (65) provided to said electromagnetic control valve and an external signal transmitted from a driving mode control device for vehicles or the like.

Patentansprüche

1. Elektromagnetisches Regelventil, bestehend aus:

einem Ventilelement (8), das sich in einer Ventilkammer (18) befindet, welche durch einen oberen Hauptkörper (7) und einen Ventilhauptkörper (17) gebildet ist;

einem Ventilsitz, mit dem das Ventilelement wiederholt in Kontakt tritt, wobei der Ventilsitz an einer Ventilöffnung (17k) in einem Kanal (17d) zwischen der Ventilkammer und einer Abgabedruck-Einführungsöffnung (17i) gebildet ist, die unterhalb der Ventilkammer gebildet ist und zu einer abgabeseitigen Einführleitung (38) eines Kompressors (20) führt;

einer Kurbelgehäuseinnendruck-Einführöffnung (17h), die auf der gegenüberliegenden

Seite der Abgabedruck-Einführöffnung von der Ventilkammer gebildet ist, wobei die Kurbelgehäuseinnendruck-Einführöffnung zu einer Kurbelkammer (21) des Kompressors führt; einer Ventileinführung (17e), die sich von der Kurbelgehäuseinnendruck-Einführöffnung zu der Abgabedruck-Einführöffnung erstreckt; einer Ventilstange (8b), die im Inneren der Ventileinführung vertikal bewegbar ist; einem Kolben (5) zum Drücken des Ventilelements in eine Ventilschließrichtung mit einer vertikal bewegbaren Verbindungsstange (6) innerhalb einer Durchgangsöffnung (7a), die durch den oberen Hauptkörper gebildet ist, wobei der Kolben oberhalb des Hauptkörpers angeordnet und in vertikaler Richtung unter der Einwirkung der Anziehungskraft einer elektromagnetischen Wicklung (15) bewegbar ist; einer für einen Innendruck-Ausgleichsöffnung (17q), die in dem Ventilhauptkörper gebildet ist und sich von der Ventilkammer zu der Kurbelgehäuseinnendruck-Einführöffnung erstreckt; einer Saugdruck-Einführöffnung (17s), die zu der Ansaugseite des Kompressors führt; einer Druckempfindlichkeitsregeleinrichtung, die in einem Raum angeordnet ist, der zu der Ansaugseite (17g) des Kompressors führt, wobei die Druckempfindlichkeitsregeleinrichtung auf die Kurbelgehäuseinnendruck-Einführöffnung des Ventilhauptkörpers weist; und einer Kolbenfeder (13) zur Aufnahme eines Kolbendrucks,

wobei die Druckempfindlichkeitsregeleinrichtung durch einen Kolben (12-1a, 12-2a) gebildet ist, der in Berührung mit der Bodenfläche der Ventilstange zur Erfassung des Druckunterschieds zwischen einem Kurbelgehäuseinnendruck und einem Ansaugdruck tritt, und wobei bei dem ermittelten Druckunterschied das Ventilelement die Strömung eines Kühlmittels aus der Abgabeöffnung (Hochtemperaturseite) zu der Kurbelgehäuseseite des Kompressors steuert.

2. Elektromagnetisches Regelventil nach Anspruch 1, bei dem

die obere Fläche des Kolbens (12-1a, 12-2a) derart angefasst ist, daß ein Abflußventil gebildet ist, das die Seitenfläche des Kolbens als Gleitabschnitt aufweist,

wobei ein anderer Seitenabschnitt an dem oberen Ende oder in der Nähe des unteren Endes des unteren Abschnitts des Ventilhauptkörpers (17) gebildet ist,

wobei das Abflußventil sich von dem unteren Ende der Ventilstange (8b) löst, wenn der Druckunterschied zwischen dem Kurbelgehäuseinnendruck und dem Saugdruck einen vorbestimmten Wert

übersteigt, und

bei dem der Seitenabschnitt des Abflußventils sich von dem Gleitabschnitt des unteren Abschnitts des Ventilhauptkörpers derart löst, daß ein Kühlmitteldruck aus der Seite des Kurbelgehäuses (21) zu der Ansaugseite (5) des Kompressors (20) freigegeben werden kann.

3. Elektromagnetisches Regelventil nach Anspruch 1 oder 2, weiterhin mit einer externen Regeleinheit (60) zur elektromagnetischen Aktivierung des Ventilelements (8) zur Steuerung der Strömung des Kühlmittels von der Abgabeseite (Hochdruckseite D) zu der Seite des Kurbelgehäuses (21) des Kompressors bei Empfang von Erfassungssignalen, die von einem Temperatursensor (64) und einem Drucksensor (65), der für das elektromagnetische Regelventil vorgesehen ist, übertragen werden und von einem externen Signal, das von einer Fahrbetriebsregelungseinrichtung für Fahrzeuge oder dergleichen übertragen wird.

Revendications

1. Vanne de commande électromagnétique comprenant :

un élément de vanne (8) situé dans une chambre de vanne (18) formée par un corps principal supérieur (7) et un corps principal de vanne (17) ;

un siège de vanne avec lequel ledit élément de vanne entre en contact à plusieurs reprises, ledit siège de vanne étant formé au niveau d'une ouverture de vanne (17k) dans un passage (17d) entre la chambre de vanne et une ouverture d'introduction de pression de refoulement (17i) formée en-dessous de la chambre de vanne et conduisant à une conduite d'introduction du côté refoulement (38) d'un compresseur (20) ;

une ouverture d'introduction de pression intérieure de carter (17h) formée sur le côté opposé de l'ouverture d'introduction de pression de refoulement par rapport à la chambre de vanne, ladite ouverture d'introduction de pression intérieure de carter conduisant à une chambre de carter (21) du compresseur ;

un guide de vanne (17e) s'étendant à partir de ladite ouverture d'introduction de pression intérieure de carter jusqu'à ladite ouverture d'introduction de pression de refoulement ;

une tige de vanne (8b) verticalement mobile à l'intérieur dudit guide de vanne ;

un plongeur (5) pour pousser ledit élément de vanne dans un sens de fermeture de vanne avec une tige de connexion verticalement mo-

bile (6) à l'intérieur d'une ouverture traversante (7a) formée à travers le corps principal supérieur, ledit plongeur étant situé au-dessus du corps principal supérieur et étant verticalement mobile en vertu de la force d'aspiration d'une bobine électromagnétique (15) ;
 une ouverture d'égalisation de pression intérieure (17q) formée dans le corps principal de vanne et s'étendant à partir de la chambre de vanne jusqu'à ladite ouverture d'introduction de pression intérieure de carter ;
 une ouverture d'introduction de pression d'aspiration (17s) conduisant au côté aspiration du compresseur ;
 un mécanisme de commande de sensibilité de pression disposé dans un espace conduisant au côté aspiration (17g) du compresseur, ledit mécanisme de commande de sensibilité de pression faisant face à ladite ouverture d'introduction de pression intérieure de carter du corps principal de vanne ; et
 un ressort de piston (13) pour recevoir de la pression de piston,

dans laquelle :

ledit mécanisme de commande de sensibilité de pression est formé par un piston (12-1a, 12-2a) qui entre en contact avec la surface inférieure de ladite tige de vanne pour détecter la pression différentielle entre une pression intérieure de carter et une pression d'aspiration, et
 la pression différentielle étant détectée, ledit élément de vanne commande l'écoulement de réfrigérant depuis le côté refoulement (côté haute pression) vers le côté carter du compresseur.

2. Vanne de commande électromagnétique selon la revendication 1, dans laquelle :

la surface supérieure du piston (12-1a, 12-2a) est chanfreinée de façon à former une vanne d'échappement qui comprend la surface latérale du piston en tant que partie coulissante, une autre partie coulissante est formée au niveau de l'extrémité supérieure ou au voisinage de l'extrémité supérieure de la partie inférieure du corps principal de vanne (17),
 la vanne d'échappement se sépare de l'extrémité inférieure de ladite tige de vanne (8b) quand la pression différentielle entre la pression intérieure de carter et la pression d'aspiration dépasse une valeur prédéterminée, et
 la partie coulissante de la vanne d'échappement se sépare de la partie coulissante de la partie inférieure du corps principal de vanne,

de sorte qu'une pression de réfrigérant peut être libérée depuis le côté carter (21) vers le côté aspiration (5) du compresseur (20).

3. Vanne de commande électromagnétique selon la revendication 1 ou 2, comprenant de plus :

une unité de commande externe (60) pour activer de manière électromagnétique ledit élément de vanne (8) pour commander l'écoulement de réfrigérant depuis le côté refoulement (côté haute pression D) vers le côté carter (21) du compresseur lors de la réception de signaux de détection émis à partir d'un capteur de température (64) et d'un capteur de pression (65) prévus pour ladite vanne de commande électromagnétique et d'un signal externe émis à partir d'un dispositif de commande de mode de conduite pour des véhicules ou analogues.

FIG. 1

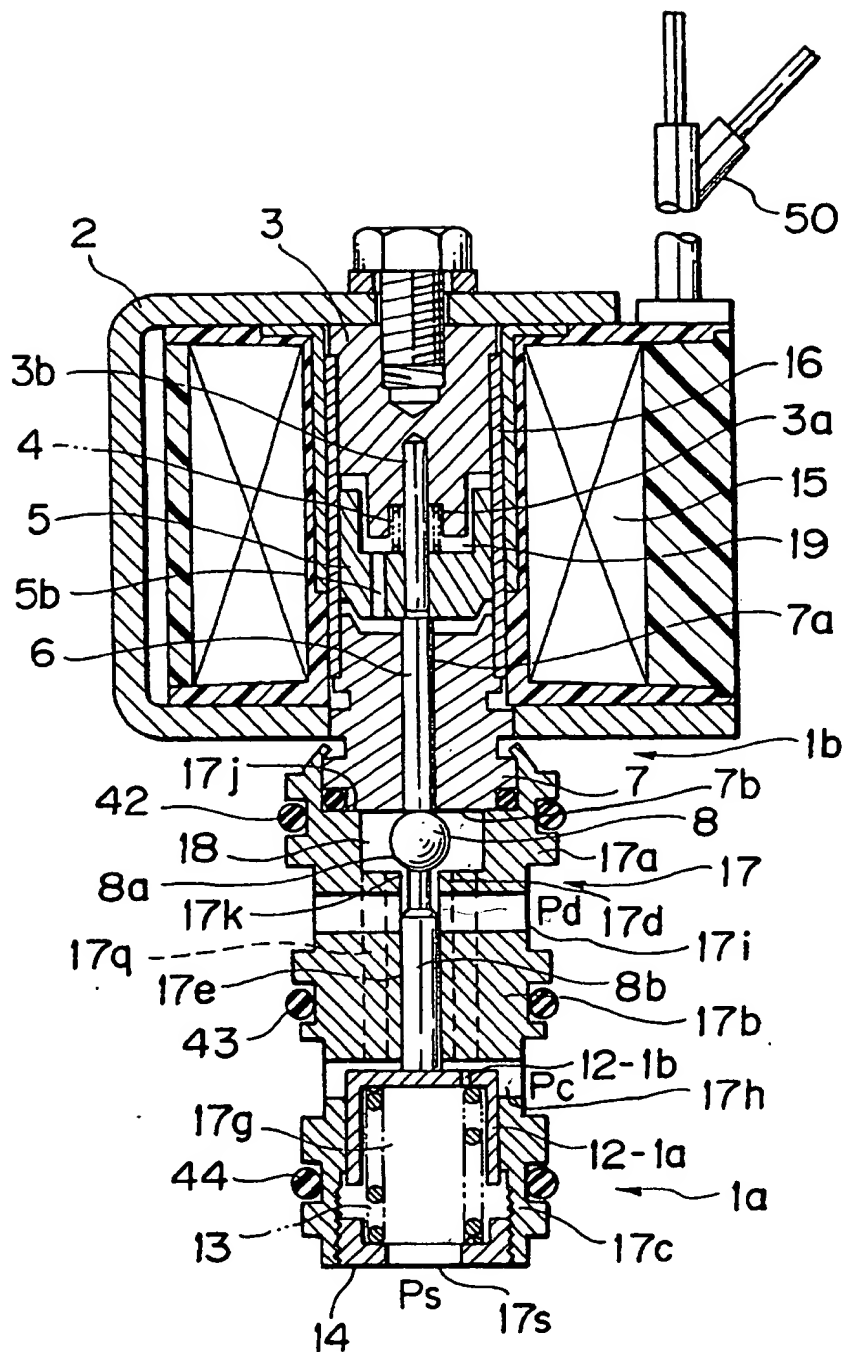


FIG. 2

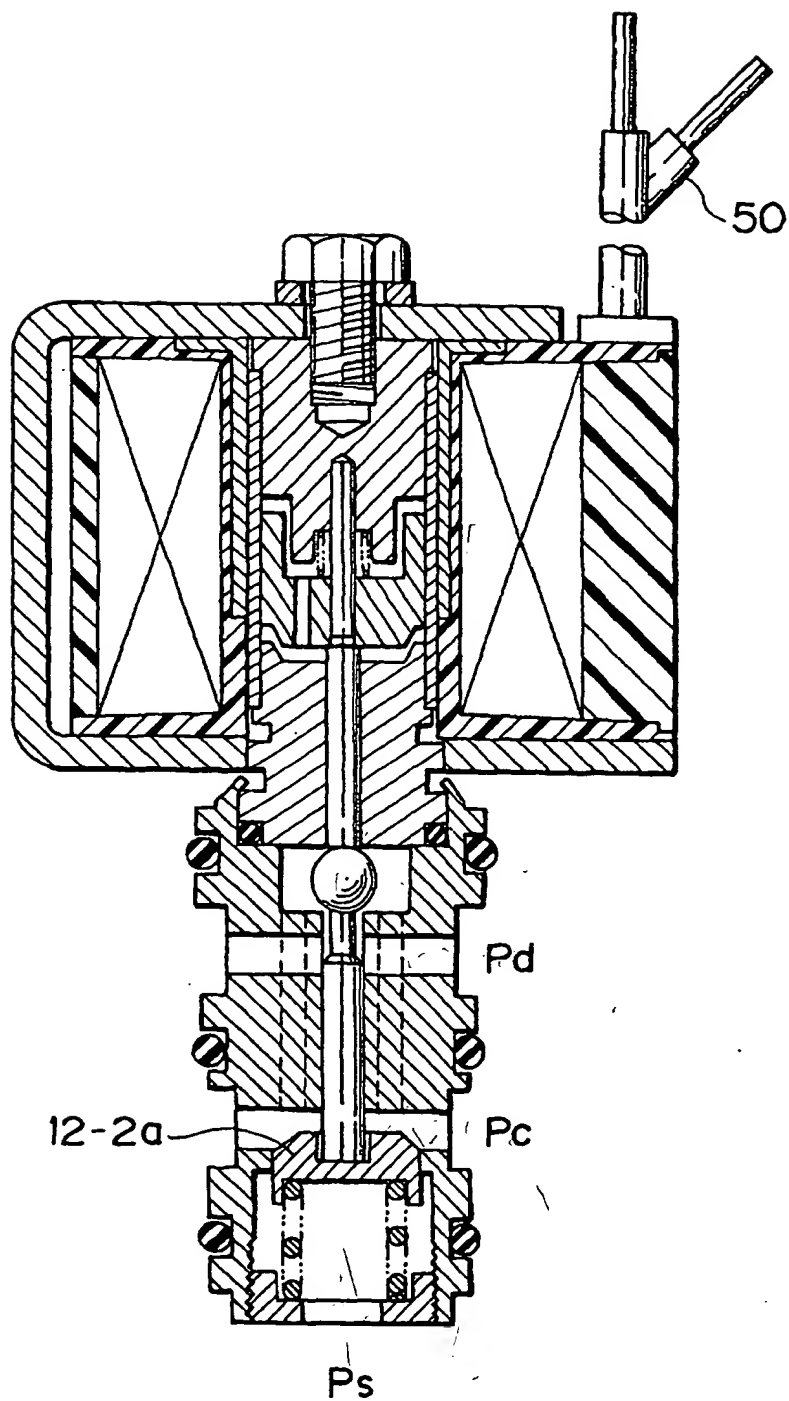


FIG. 3

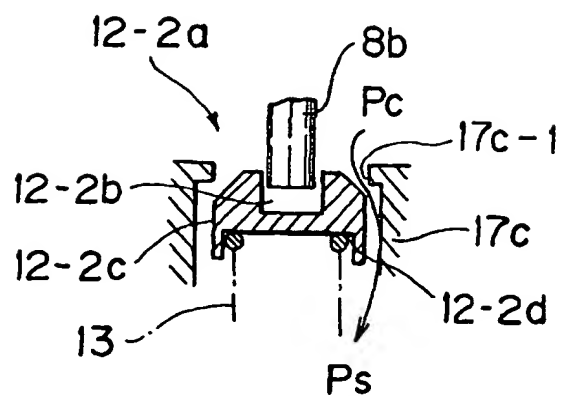


FIG. 4

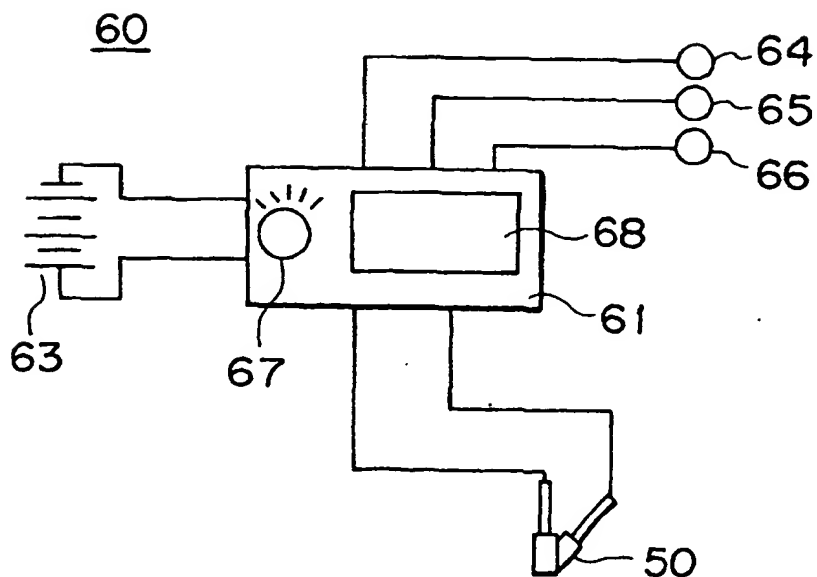


FIG. 5
PRIOR ART

